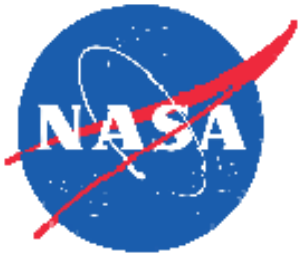

CORONAL IMAGING WITH THE SOLAR ULTRAVIOLET IMAGER

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Geostationary Operational Environmental Satellite (GOES-R)

Launched: November 19, 2016

Operational: December, 2017

Nadir-pointed instruments:

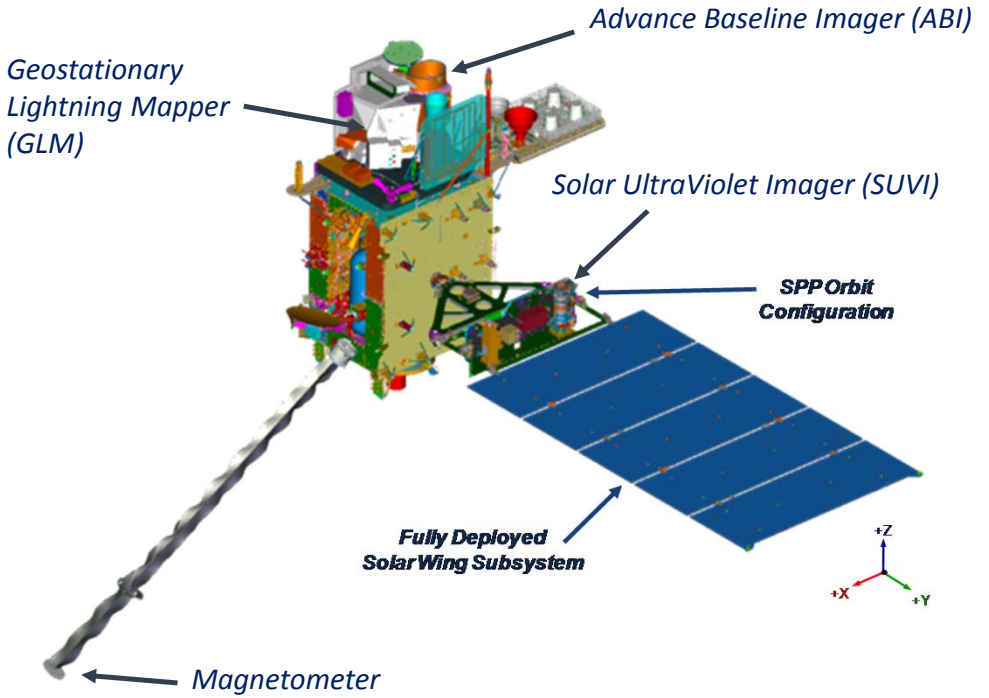
- Advance Baseline Imager (ABI)
- Geostationary Lightning Mapper (GLM)

Sun-pointed instruments:

- EUVS and X-ray Irradiance Suite (EXIS)
- Solar UltraViolet Imager (SUVI)

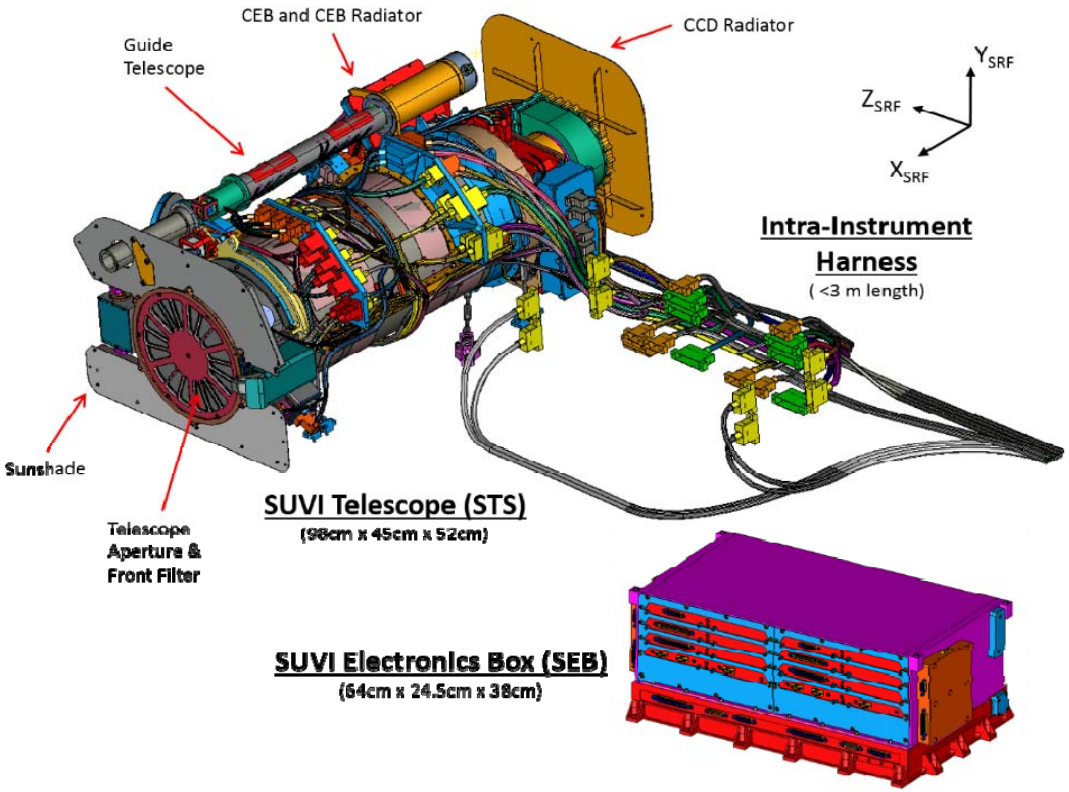
Bus-mounted instruments:

- Space Environment In-Situ Suite (SEISS)
- Magnetometer



Solar UltraViolet Imager (SUVI)

- Generalized Cassegrain Telescope
- Multilayer coated primary and secondary mirrors
- Six channels:
  - 9.4nm, 13.1 nm, 17.1nm, 19.5nm, 28.4nm, 30.4nm
- Entrance and analysis filters forbandpass & OOB rejection
- 53 arcmin x 53 arcmin CCD
- Guide Telescope (GT) provides Sun-pointing information
- Spacecraft controls gimbals with the GT data



Motivation

Observation:

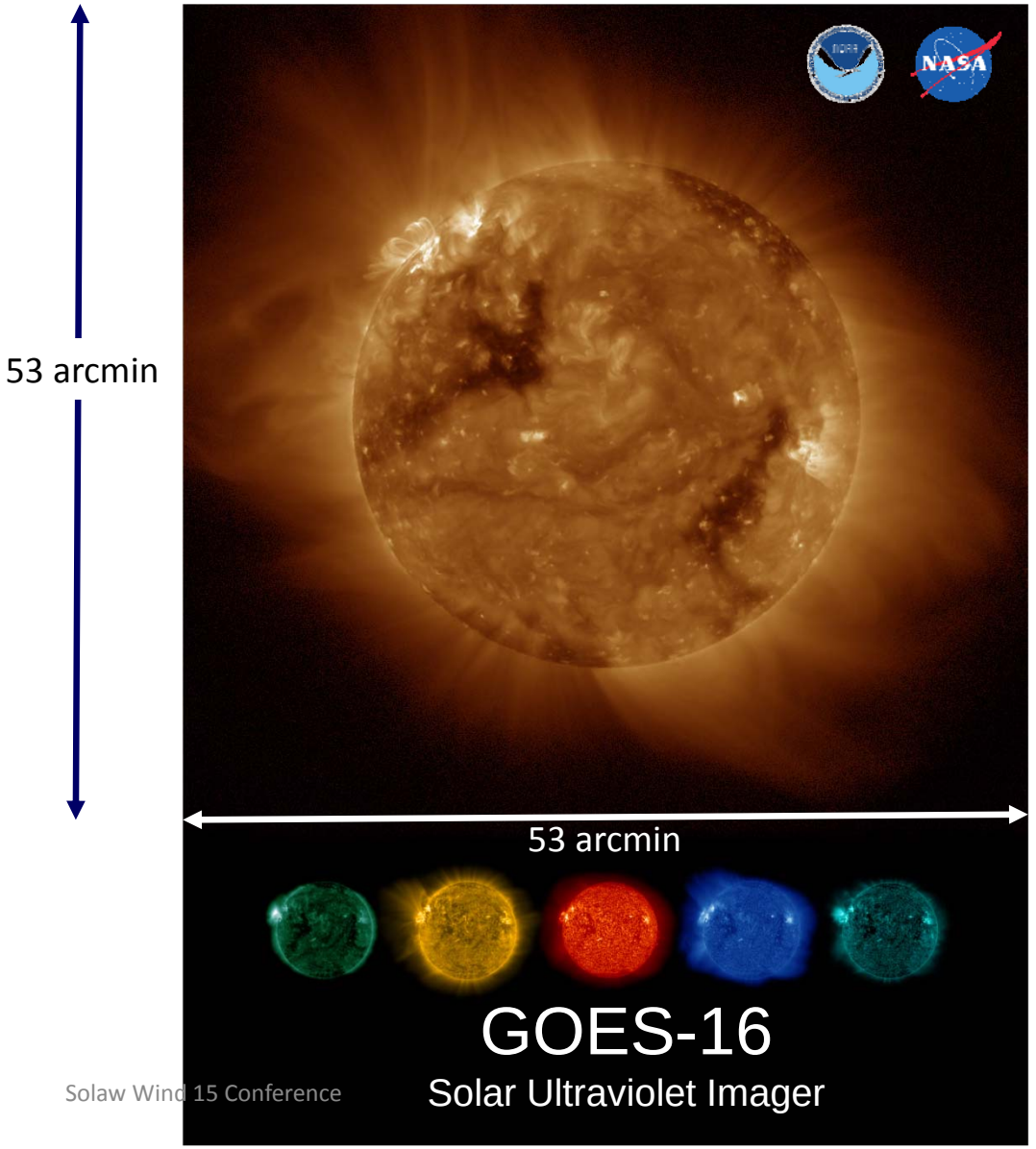
- SUVI image shows significant corona
  - ❖ Largest among solar imagers
- No UV corona imagers

Action:

- Explore UV corona up to a few solar radii
- Investigate impacts on spacecraft

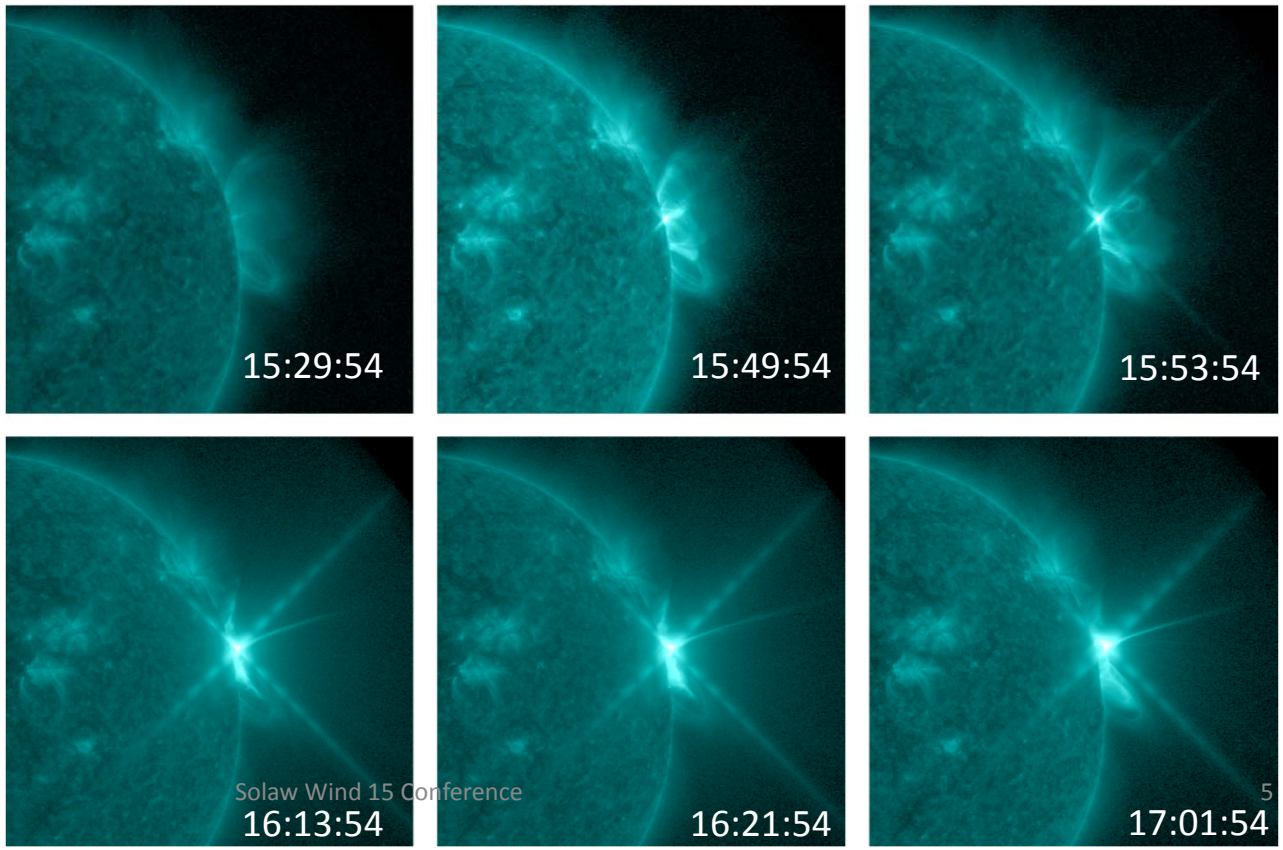
Implementation:

- Develop an operational concept



Caught on camera: X9 flare

2017 September 10*

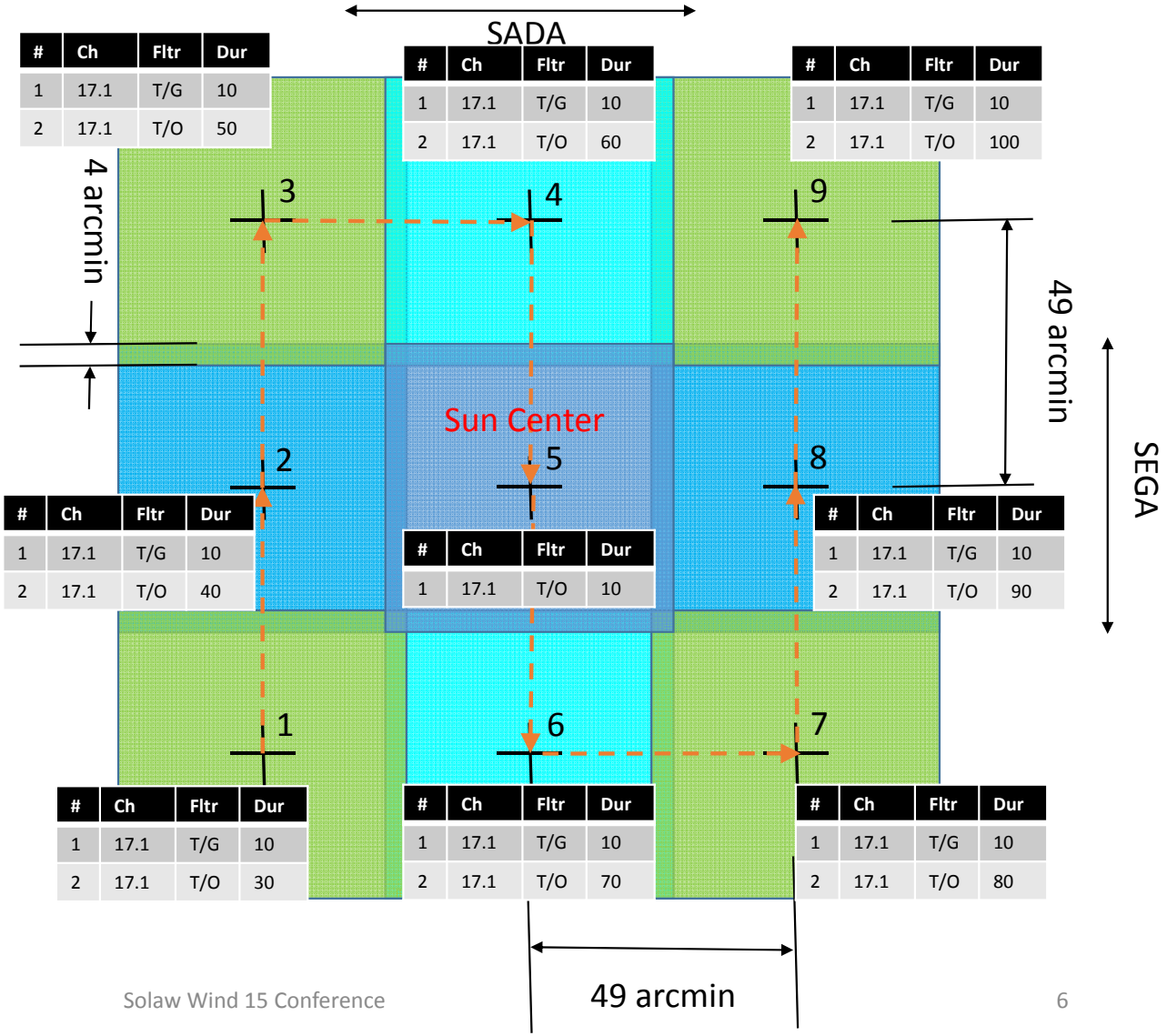


* Seaton, et al, The Astrophysical Journal Letters, 852:L9 (7pp), 2018 January 1

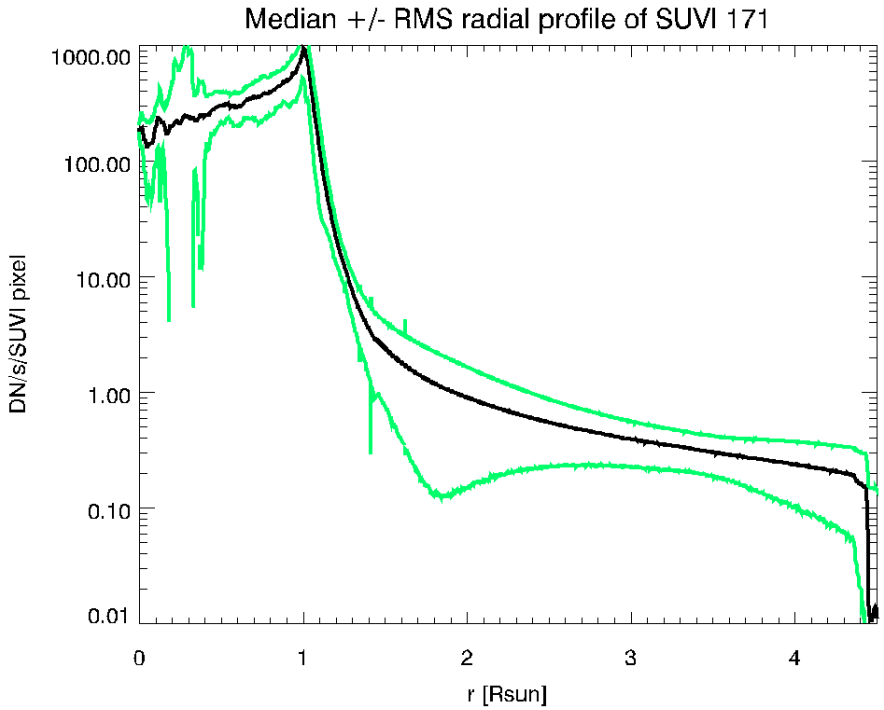
Off-points

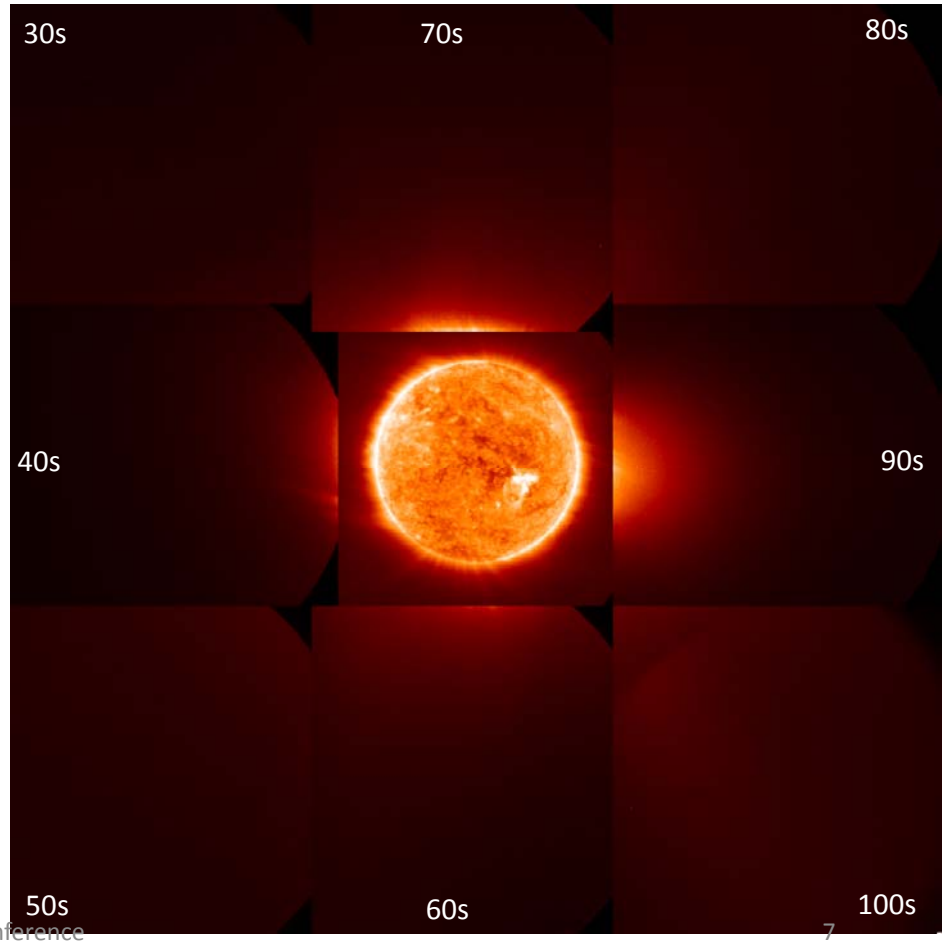
- Distributed symmetrically around the Sun center
- 17.1 nm & 19.5 nm
- Varying exposures
- Accounts for pointing errors

- **Executed on February 13, 2018**



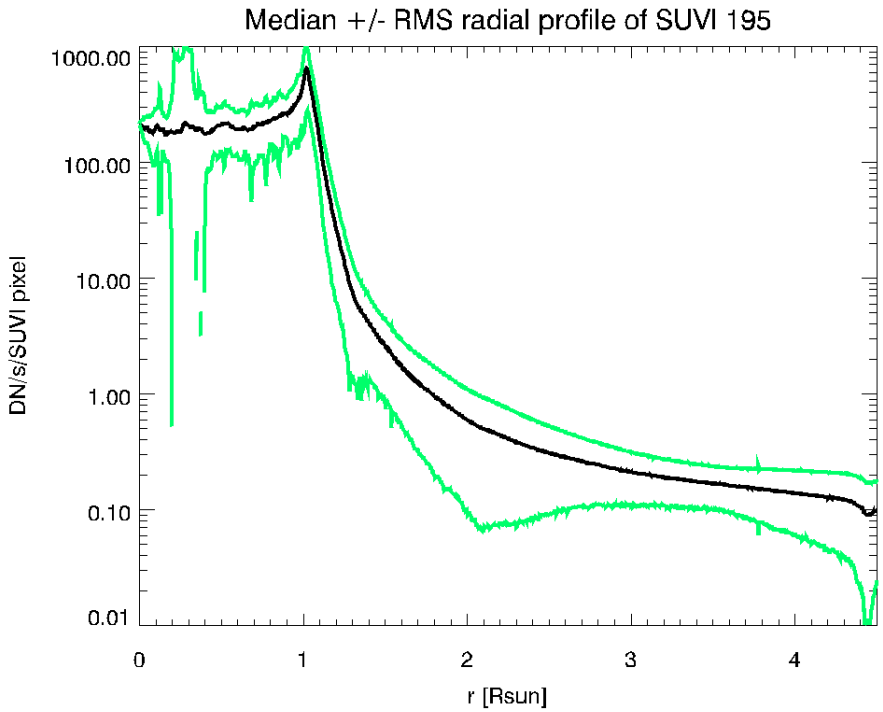
17.1nm Composite

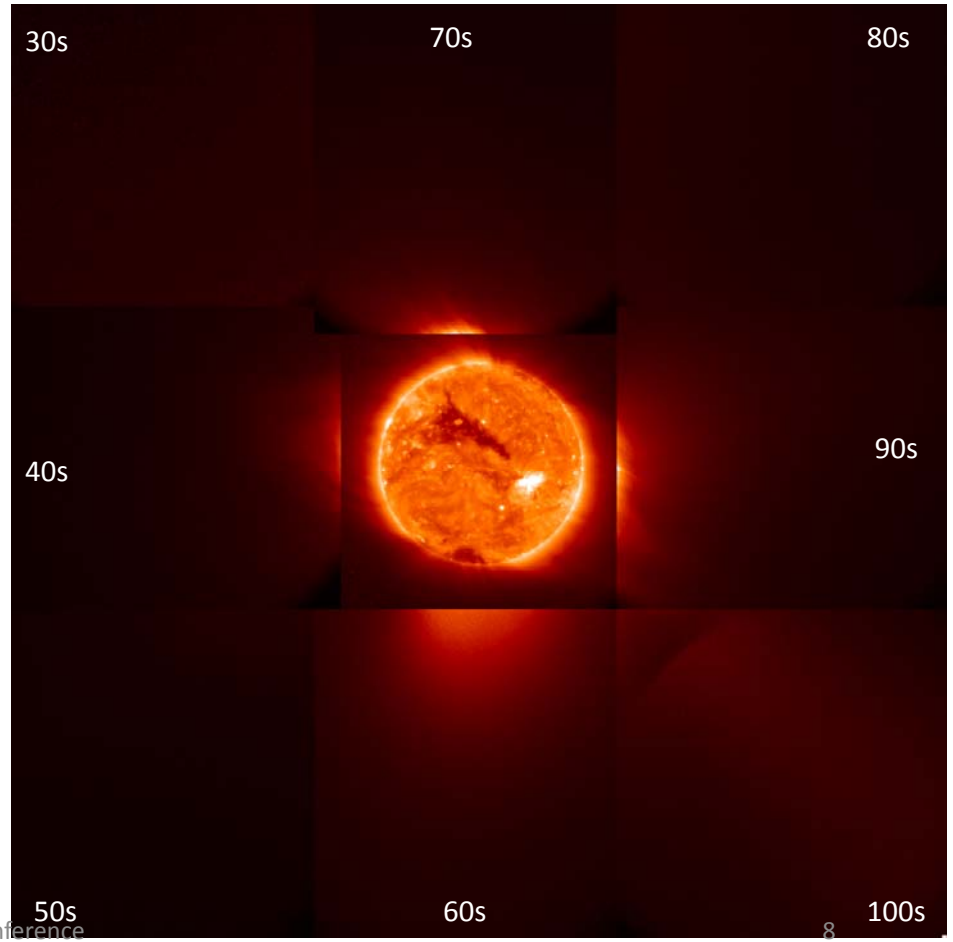




$4.7*R_{sun}$

19.5nm Composite



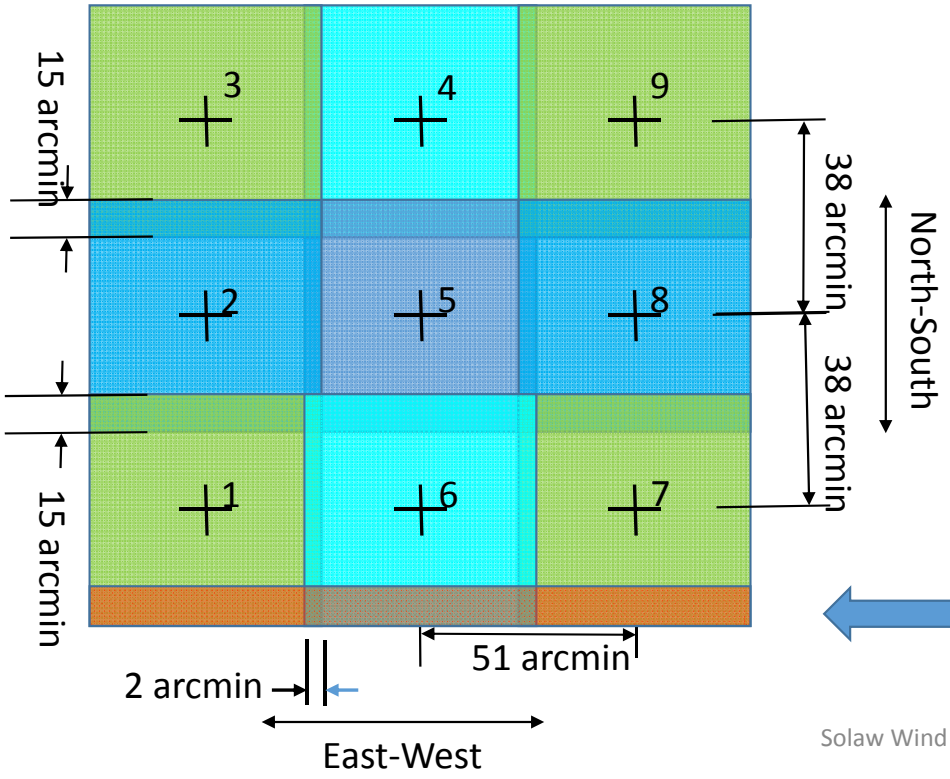


Refinements

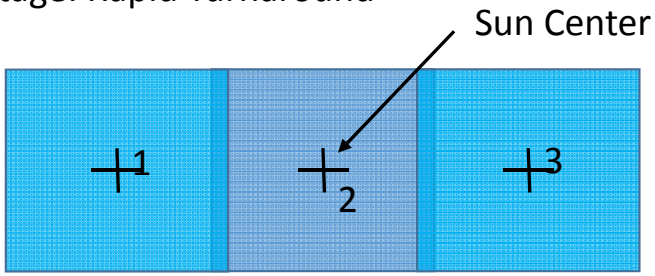
- 17.1 nm vs 19.5 nm
- Exposure duration reduced w/on-chip binning
- Overlap, accounting for pointing errors, reduced to 2 arcmin
- Other off-points: 3 panels vs. 9, stare at an off-point
- Dynamic disturbances on spacecraft reduced
- Operational concept
  - Patrol mode vs on-demand
  - Use other instrument data as predictive tool
- 3-phase execution on GOES-17

Off-points

Final image size: **155 x 114 arcmin**
Advantage: Large imaging area



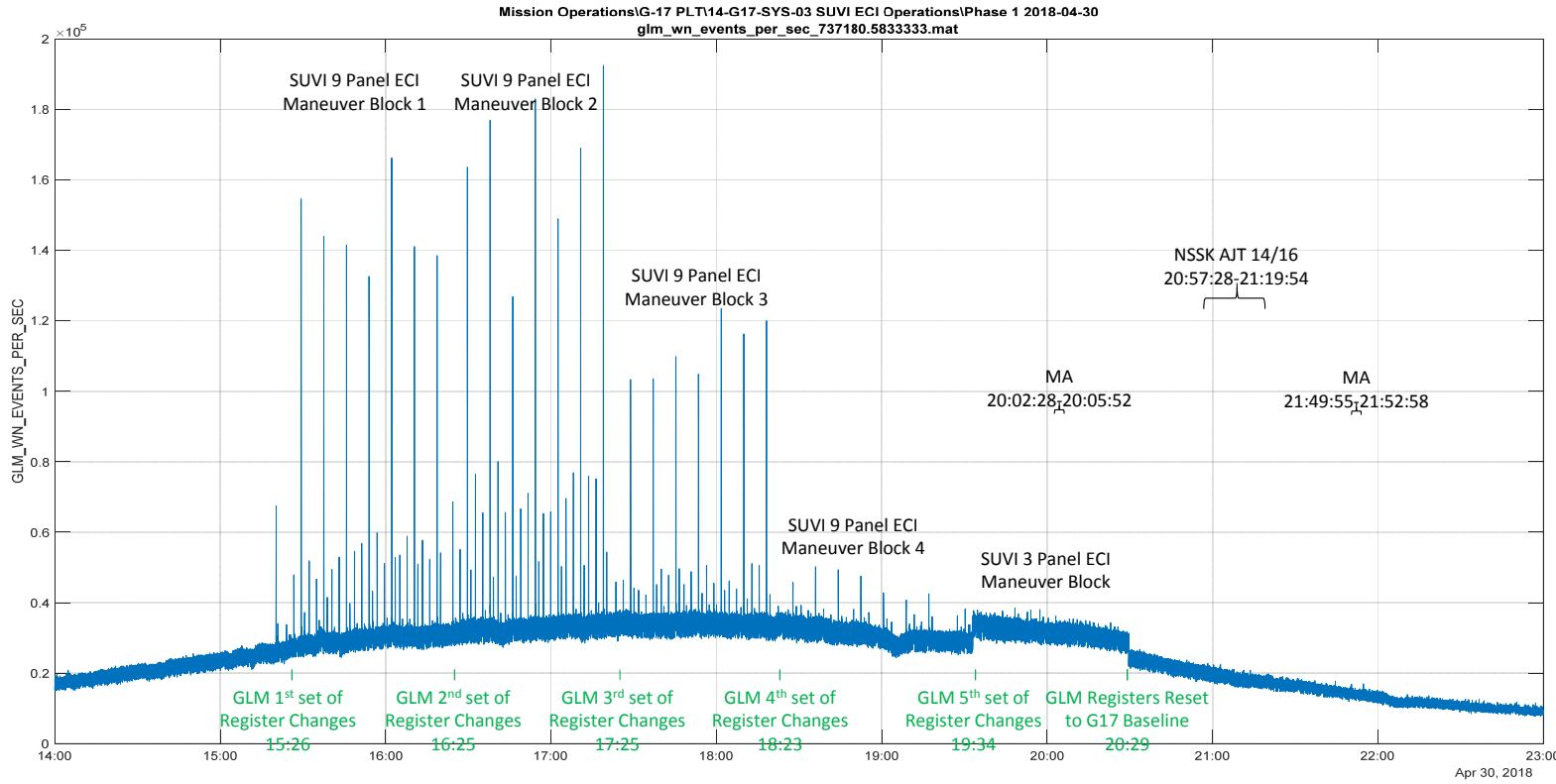
Final image size: **155 x 53 arcmin**
Advantage: Rapid Turnaround



- Covers 4.5x Solar radii in E-W
- 171A and/or 195A
- Fast refresh rate: 4.35 min (single channel)
  - Max observable CME rate: > 4500 Km/s
- 5.33 min for two channels

- Overlap in N-S eliminates vignetting
- Covers 3.5x Solar radii in N-S; > 4.5x in E-W
- Refresh rate: 8.2 min
  - Max observable CME rate: ~4500 Km/s

Phase 1 Execution on GOES-17: Reduced Dynamic Disturbances



Next Steps

- Two more steps planned
  - ➢ Implement SUVI imaging for the off-points on GOES-17: 72 hours; analyze data
  - ➢ Run a patrol mode for 1-2 week period
- ➢ Process data and correlate with known events from instruments: EXIS, LASCO CCOR2, SDO/AIA, SOHO, etc.

EUV Solar Coronal Imaging – new frontier?

Backup

Mid Speed and High Speed CME Velocity Events

- Mid Speed (> 1000 to 2000 km/sec) and High Speed (> 2000 to 3400 km/sec) CME events are infrequent over a 10 year period. Mid Speed CMEs are only 3.5% of all CMEs, while High Speed CMEs are only 0.3% of all CMEs.
- However, Mid Speed and High Speed CME events are often Geoeffective. The combined number of Mid Speed and High Speed CME events (318) is very close to the combined number of Category G3, G4, and G5 Geomagnetic Storm events (304) over an 11 year Solar Cycle

	# of Observed Events, 1996-2005	% of CME Events
Low Speed CME Events, 200 to 1000 km/sec	7980	96.2%
Mid Speed CME Events, > 1000 to 2000 km/sec	291	**3.5%**
High Speed CME Events, > 2000 to 3400 km/sec	27	**0.3%**
All CMEs	**8298**	**100.0%**

For the 9 panel case, the CME velocity observed can be: > 3500 Km/s